Climate Scenarios in East Asia and China Using the NCC/IAP T63 Coupled Model

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- ***The increased concentration of greenhouse gases in the atmosphere enhances the absorption and emission of infrared radiation, thus influenced climate.***
- ***More and more scientific evidence show human induced greenhouse effects play an important role in the observed climate change.***

- ***Numerical models are employed in the studies, in the world and in China.***

- ***The talk today is focused on how we developing regional climate scenarios in East Asia and China, and our preliminary results.***

Outline

- *Model Description*
- *Climate change over East Asia and China*
- *Climate change in summer monsoon in East Asia*
- *Change in winter monsoon in East Asia*
- *Summary*

Models Description

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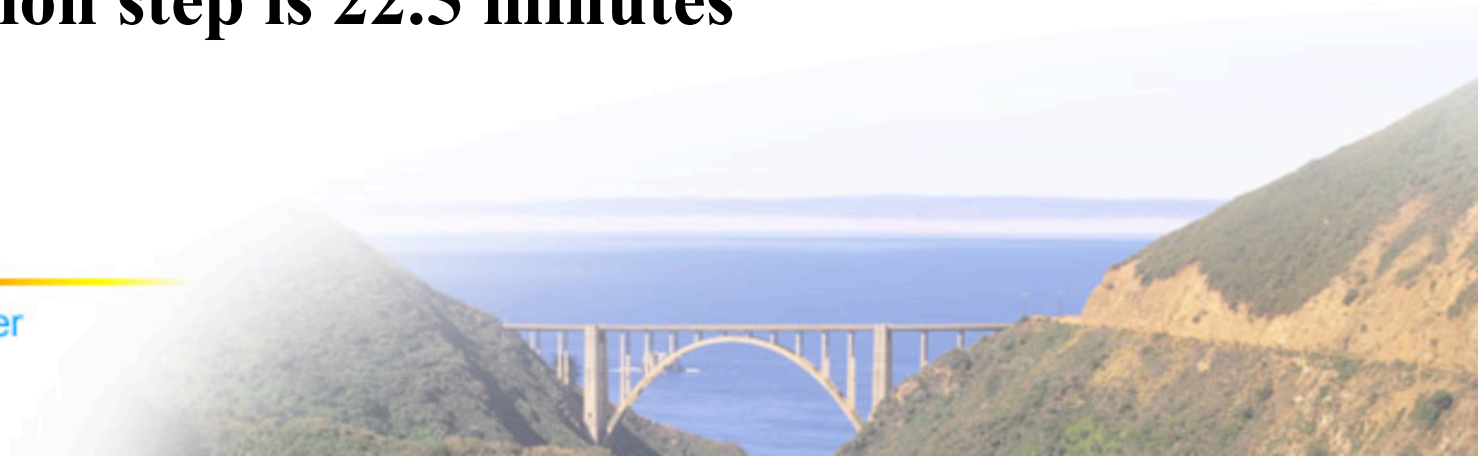
Models Description

- **The atmospheric component of the model (AGCM) has 16 levels with a horizontal resolution of 1.875 degree of latitude by 1.875 degree of longitude, which produces a global grid of 192°96 grid cells;**

- **The reference pressure is 1013.25hPa, time integration step is 22.5 minutes**

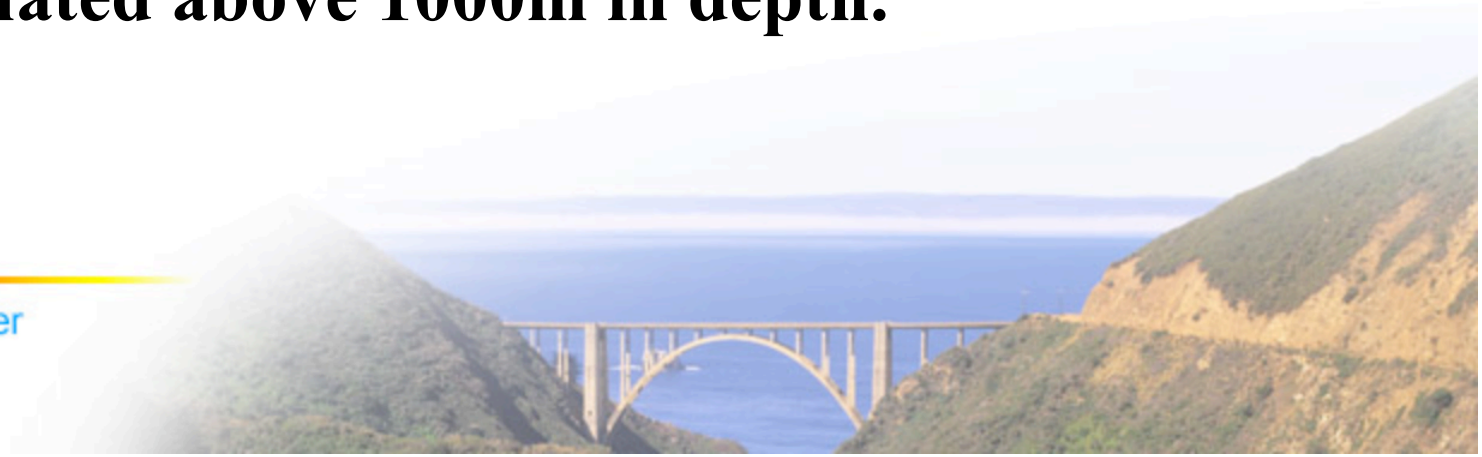


Models Description

- **Elected semi-implicit time integration method for divergence temperature and surface pressure.**
- **Using time filter method hold back calculation wave increasing.**
- **Improved conservation of mass during the long-term integration;**

Models Description

- **The oceanic component of the model (OGCM) was developed by IAP (Institute of Atmospheric Physics, CAS). It uses a triangular-truncated spectral horizontal grid system, which has the same horizontal resolution as the AGCM.**
- **There are 30 levels in vertical, of which 20 levels are situated above 1000m in depth.**



Models Description

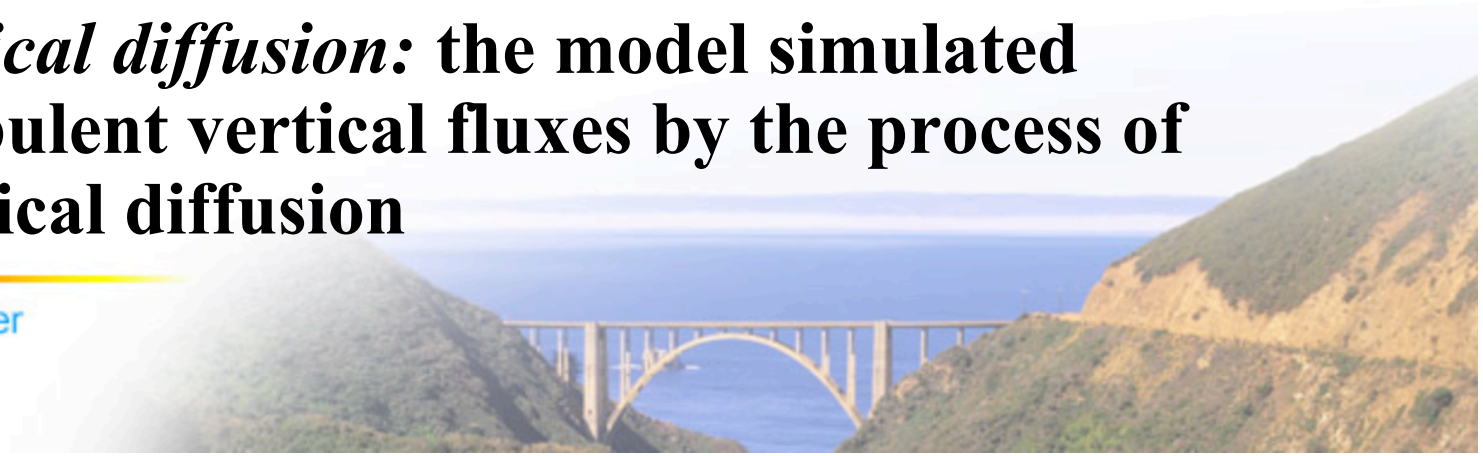
- **Modified monthly flux anomaly coupling scheme and daily flux anomaly coupling scheme have been developed and are used to obtain a coupled ocean-atmospheric general circulation model.**

Models Description

- **Including following parameterization scheme of physical processes:**

✓ ***radiation scheme:*** **considered cloud and radiation each other process in detail and the scatter process of cloud to radiation. The gases absorbers include H_2O, CO_2 and O_3 and aerosols is prescribed**

✓ ***vertical diffusion:*** **the model simulated turbulent vertical fluxes by the process of vertical diffusion**



Models Description

- ✓ ***gravity wave drag***
- ✓ ***convection:*** **mass flux scheme for deep, shallow and mid-level convection clouds are represented by a bulk model and include updraft and downdraft mass fluxes**
- ✓ ***land-surface processes***
- ✓ ***sea-ice:*** **thermodynamic sea-ice**

Experiments

Model simulation from 1900~2100 (2050 so far)

Scenarios (so far) A2: SRES —A2

B2: SRES—B2

Based on: 1961~1990, 30 yr's mean

Climate change over East Asia and China

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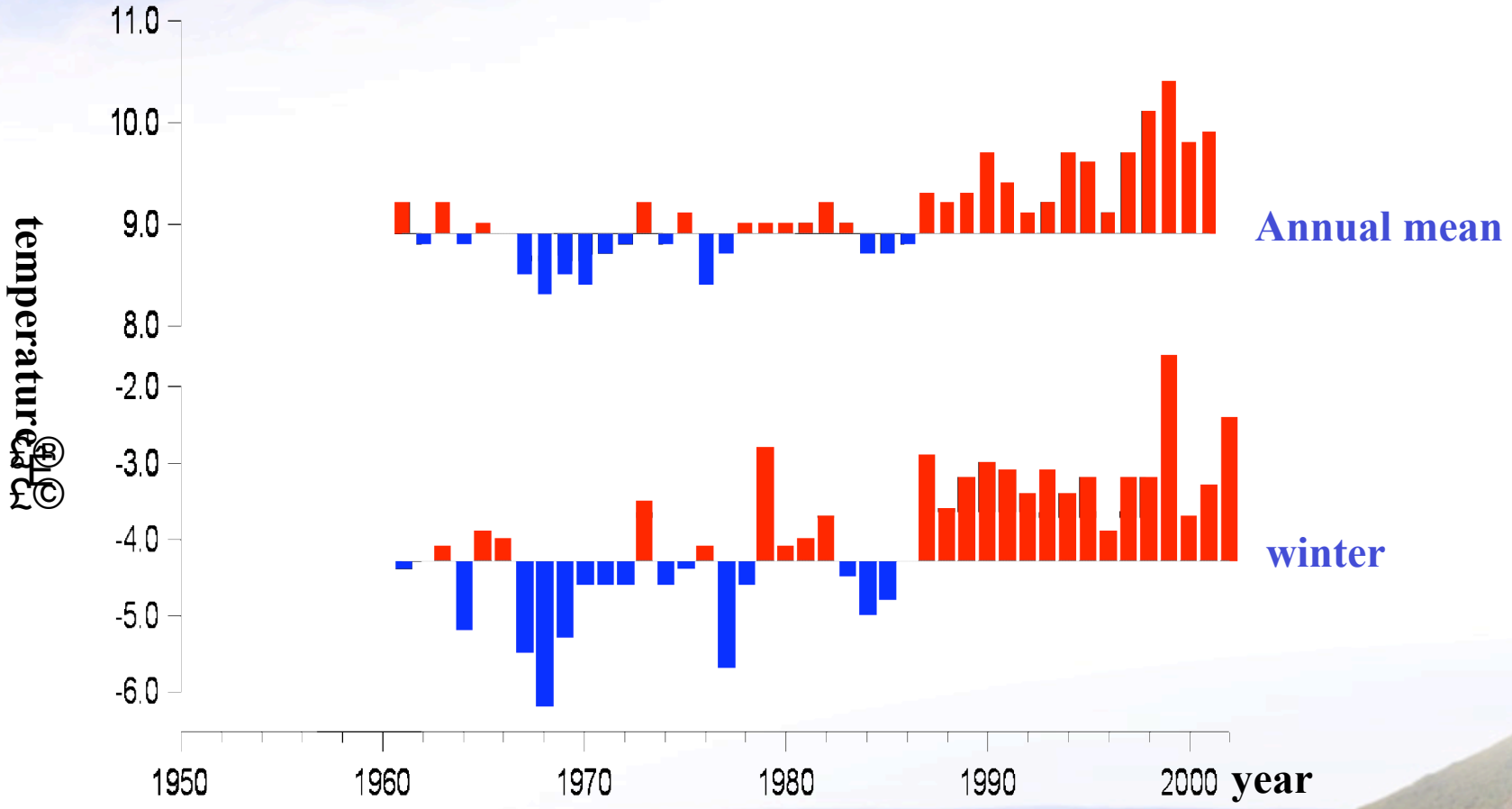
Annual mean temperature change in China



Since 1985,China has experienced 16 warming winter

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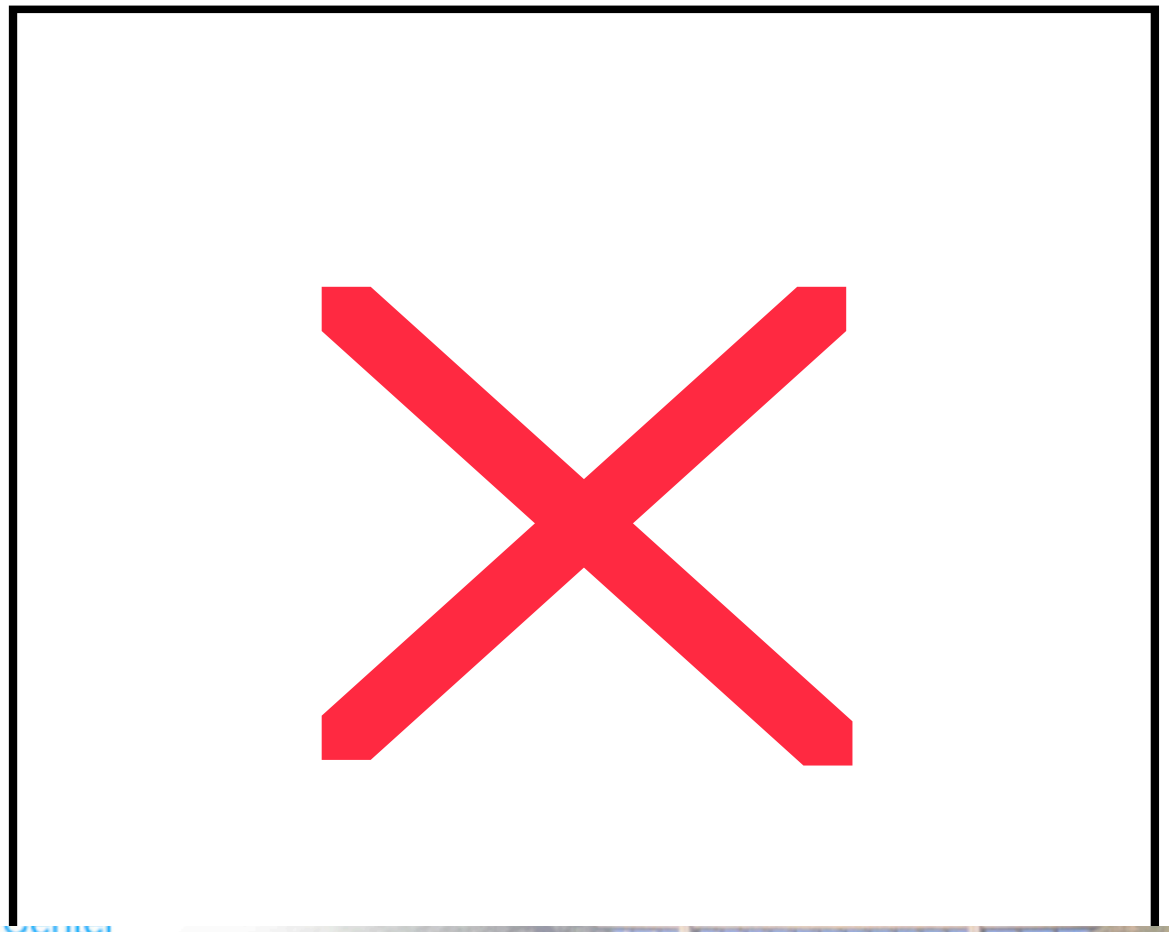
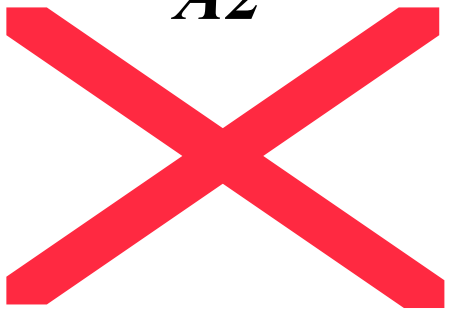
Long-term trend of annual mean surface temperature(%/10a)(1951~1999)(zhai,2002



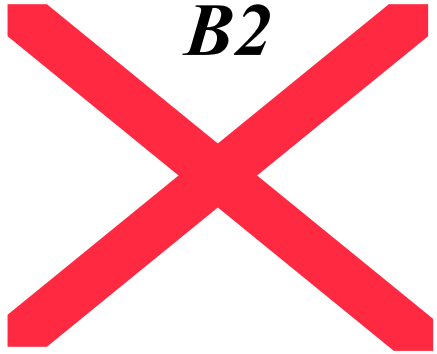
The change of temperature over East Asia in 21st century (unit:°Ê/SRES)

A2



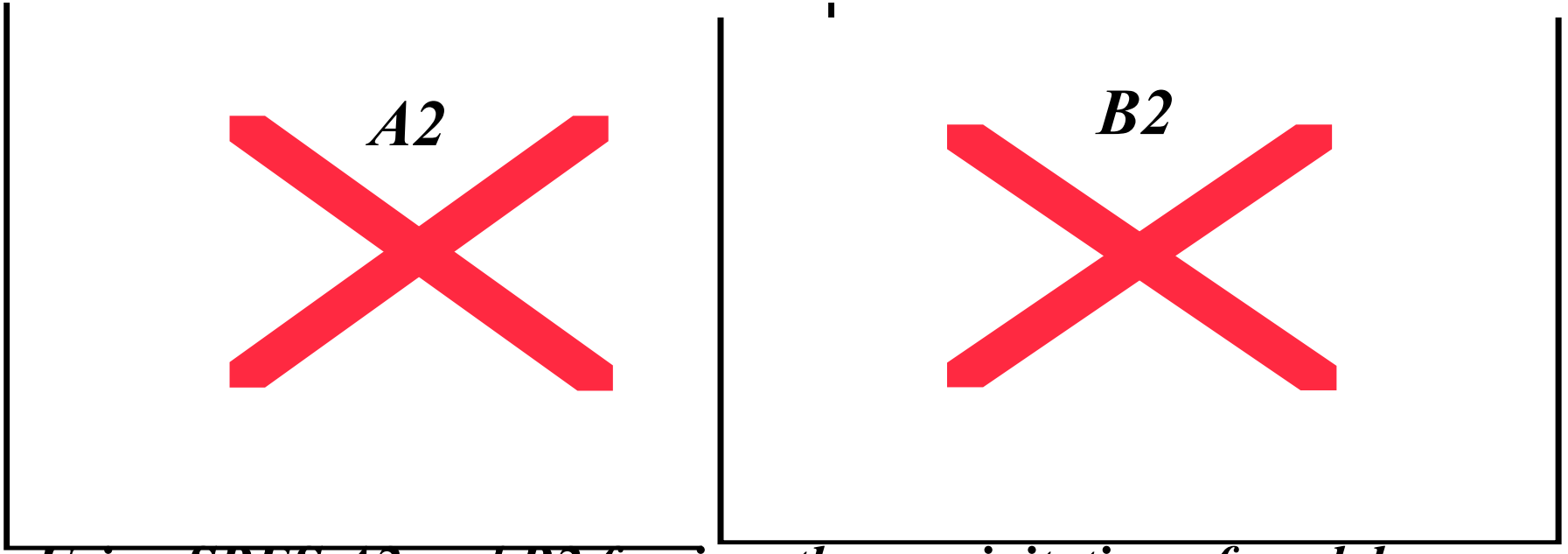
The mean temperature will increase 1.1~1.8 °Ên 2030 and 1.9~3.8°Ên 2050 year and 5.3~9.5°Ên the end of 21st by A2 scenario.

B2



The mean temperature will increase 1.0~1.8 in 2030 and 1. 9~3.6°Ên 2050 year and 3.2~6.9°Ên the end of 21st by B2 scenario.

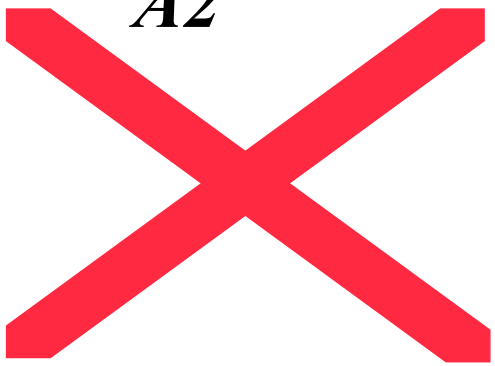
Change of annual mean precipitation over East Asia in 21st century (unit: %)



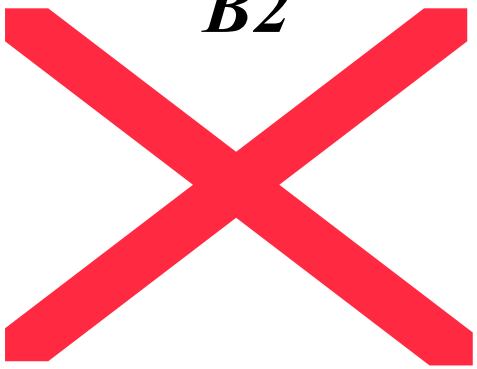
Using SRES A2 and B2 forcing, the precipitation of models mean will increase 10% and 8% compared with 1961~1990 over East Asia in the end of 21st.

Change of annual mean temperature in China in 21st century (unit:°Ê£©

A2

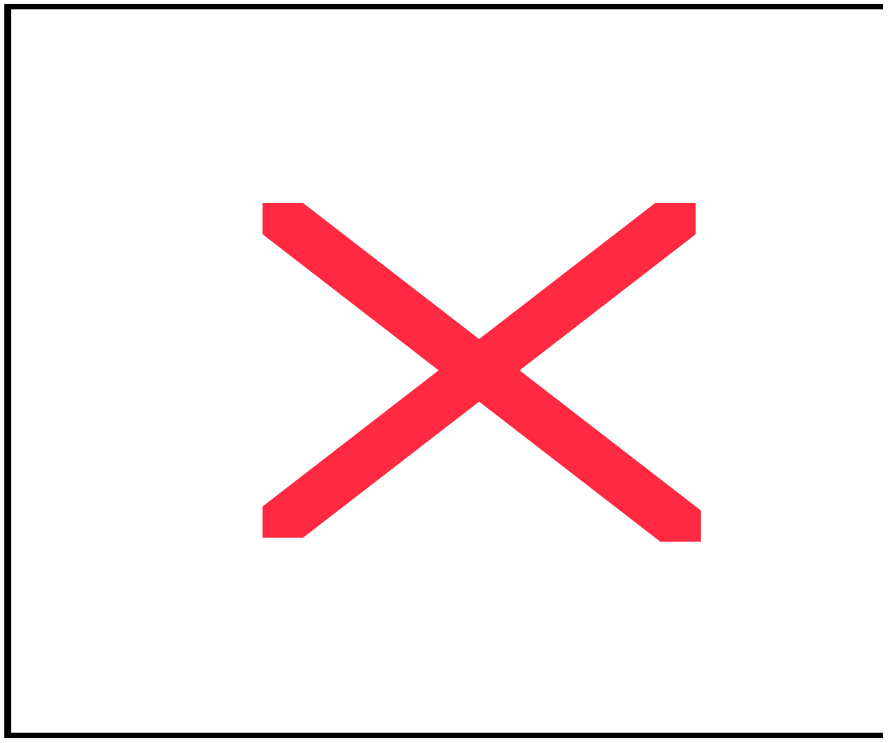


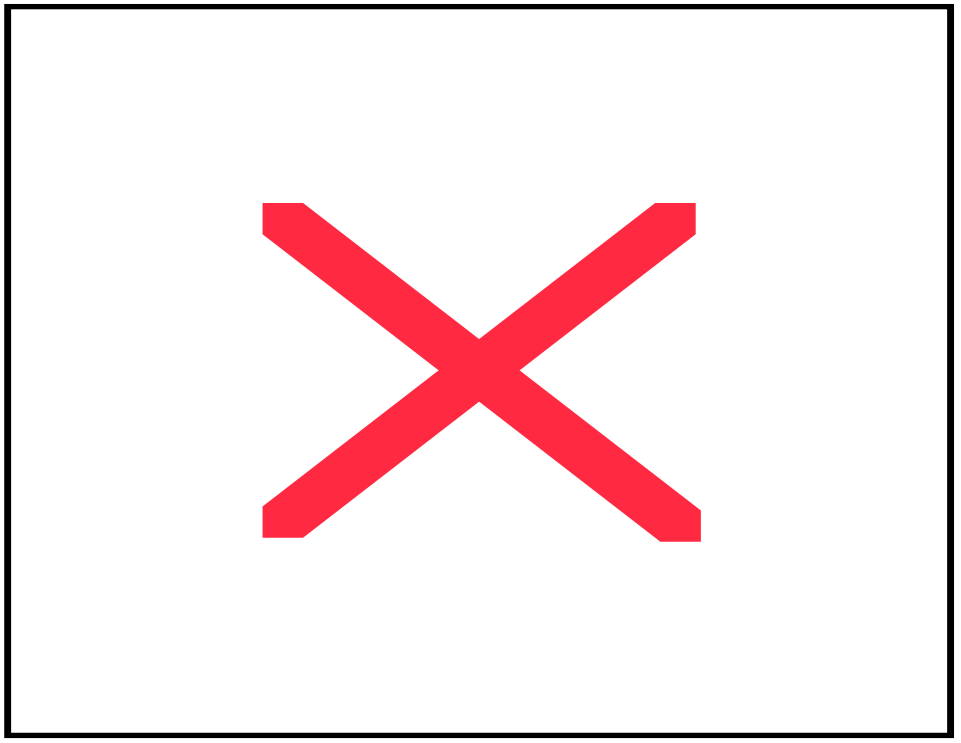
B2



Using SRES A2 forcing for the end of 21st century models mean temperature increasing is 5.5°ĘB2 is 3.9 °Ê

Spatial distribution of annual mean temperature change over East Asia (unit:°Ê£©





Annual mean temperature will increase in East Asia and China, especially, in north western and north eastern of China.

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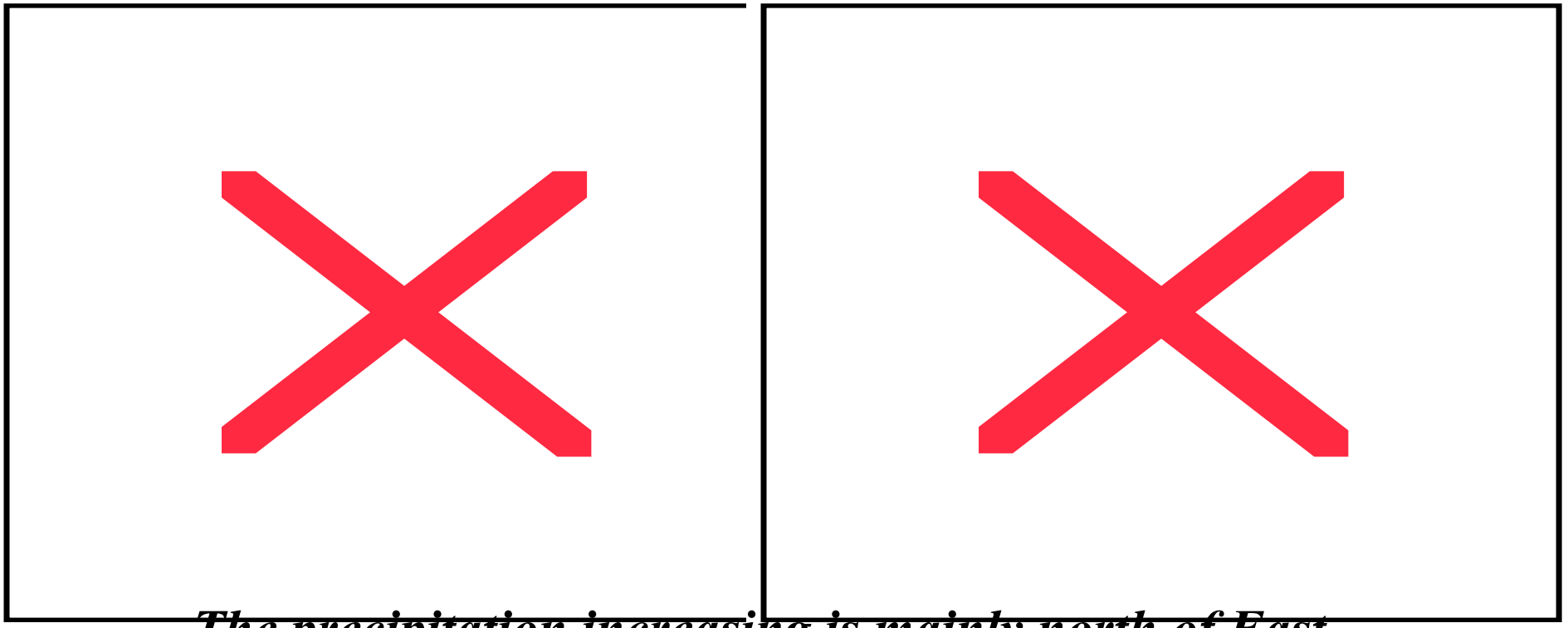
Spatial distribution of annual mean precipitation change over East Asia (unit:%£©



The precipitation increasing is mainly north of East Asia and India monsoon area in 2050~2059 year.

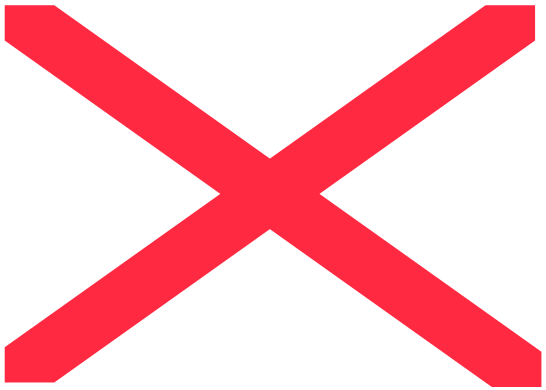
Change of summer monsoon in Asia

Asian summer monsoon is a main component of the Asian summer monsoon system.

It plays an important role in the weather and climate change in the region.

It is very important to understand Asian monsoon change in the future.

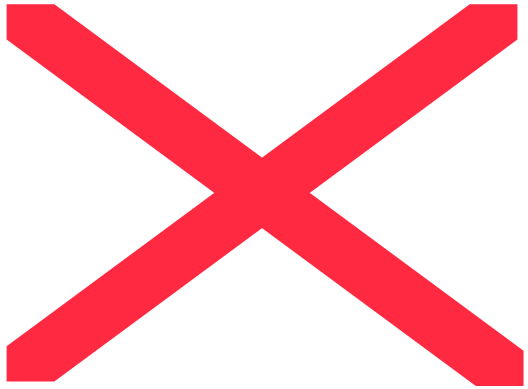
Time-series of summer monsoon index (JJA) in South Asia (1991~2050)



Webster and Yang's monsoon Index define: region average U850-U200

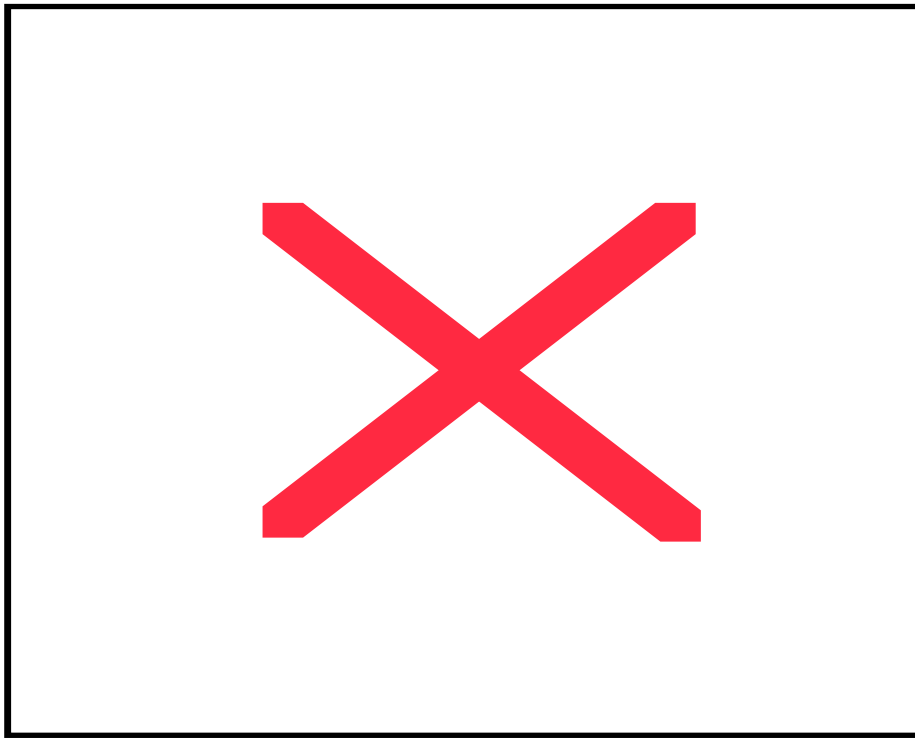
The monsoon becomes intense over South Asia Monsoon region in the future 50 years, especially in B2 scenario.

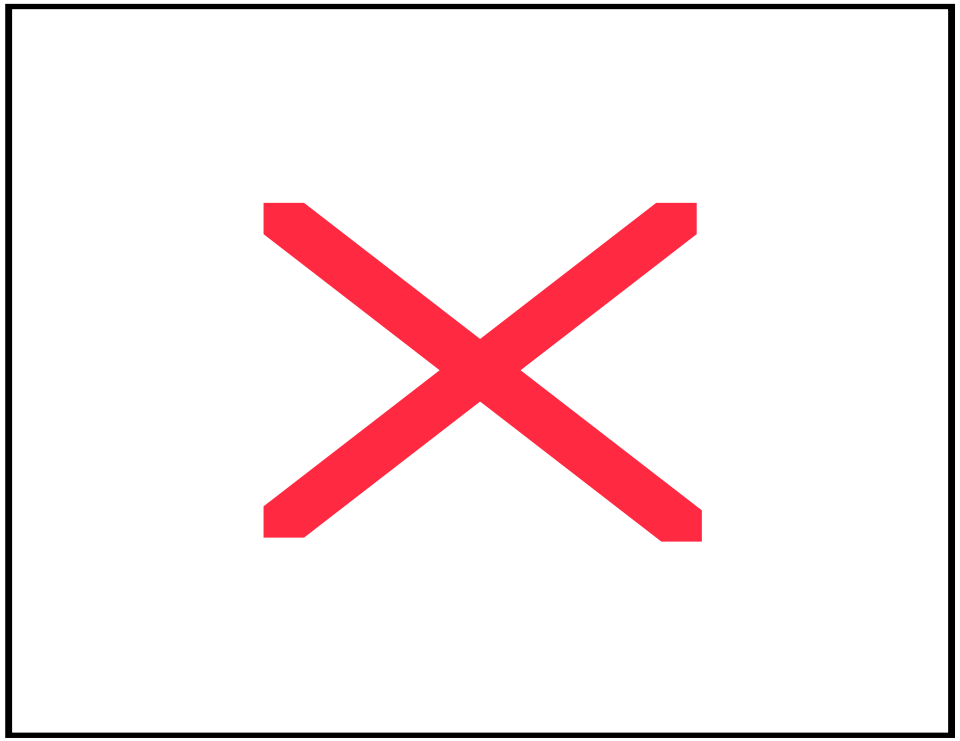
Time-series of summer monsoon index (JJA) in South China Sea (1991~2050)



Intensity of monsoon over South China Sea (SCS) monsoon becomes stronger

850 hPa U (m/s) change in summer





Tropical monsoon intense

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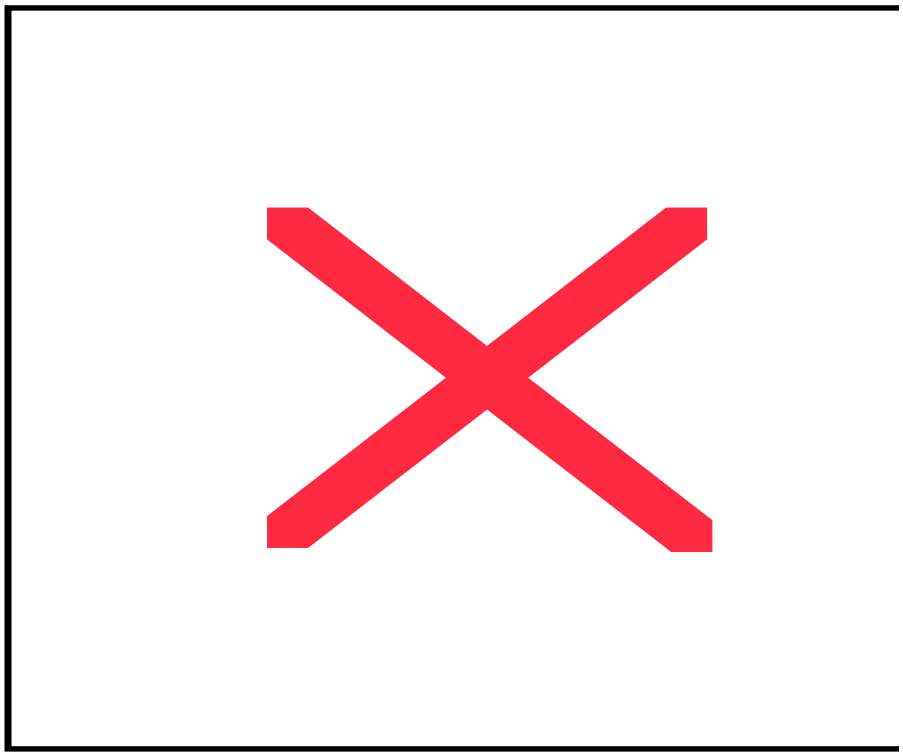
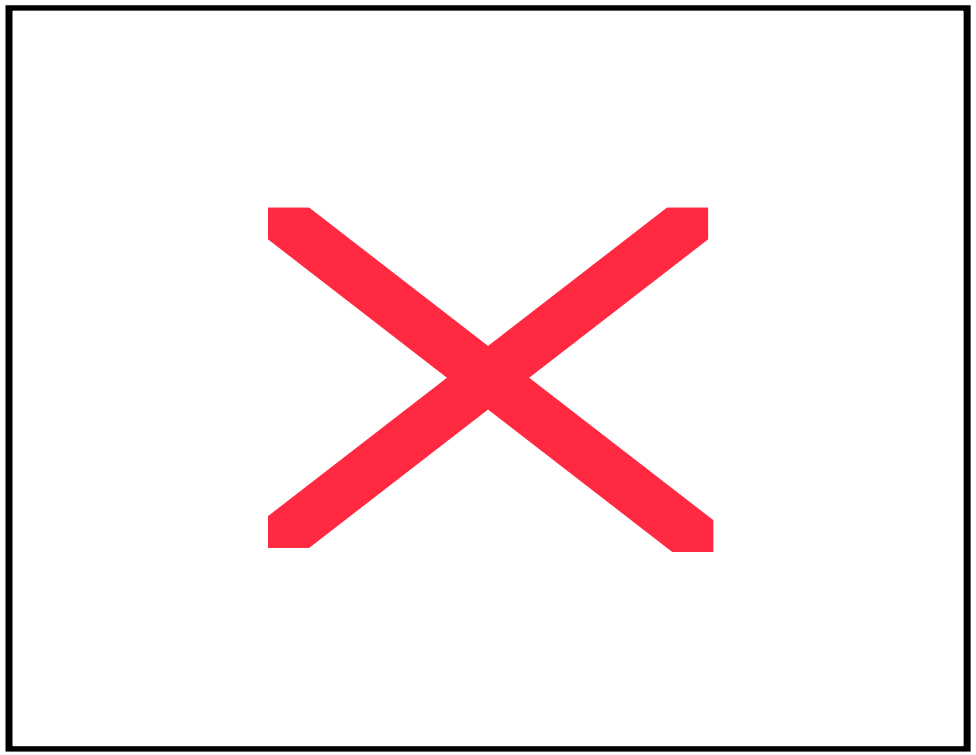
850 hPa V (m/s) change in summer





Stronger meridional wind in coastal China, leads to more precipitation in summer.

Change in winter monsoon in East Asia

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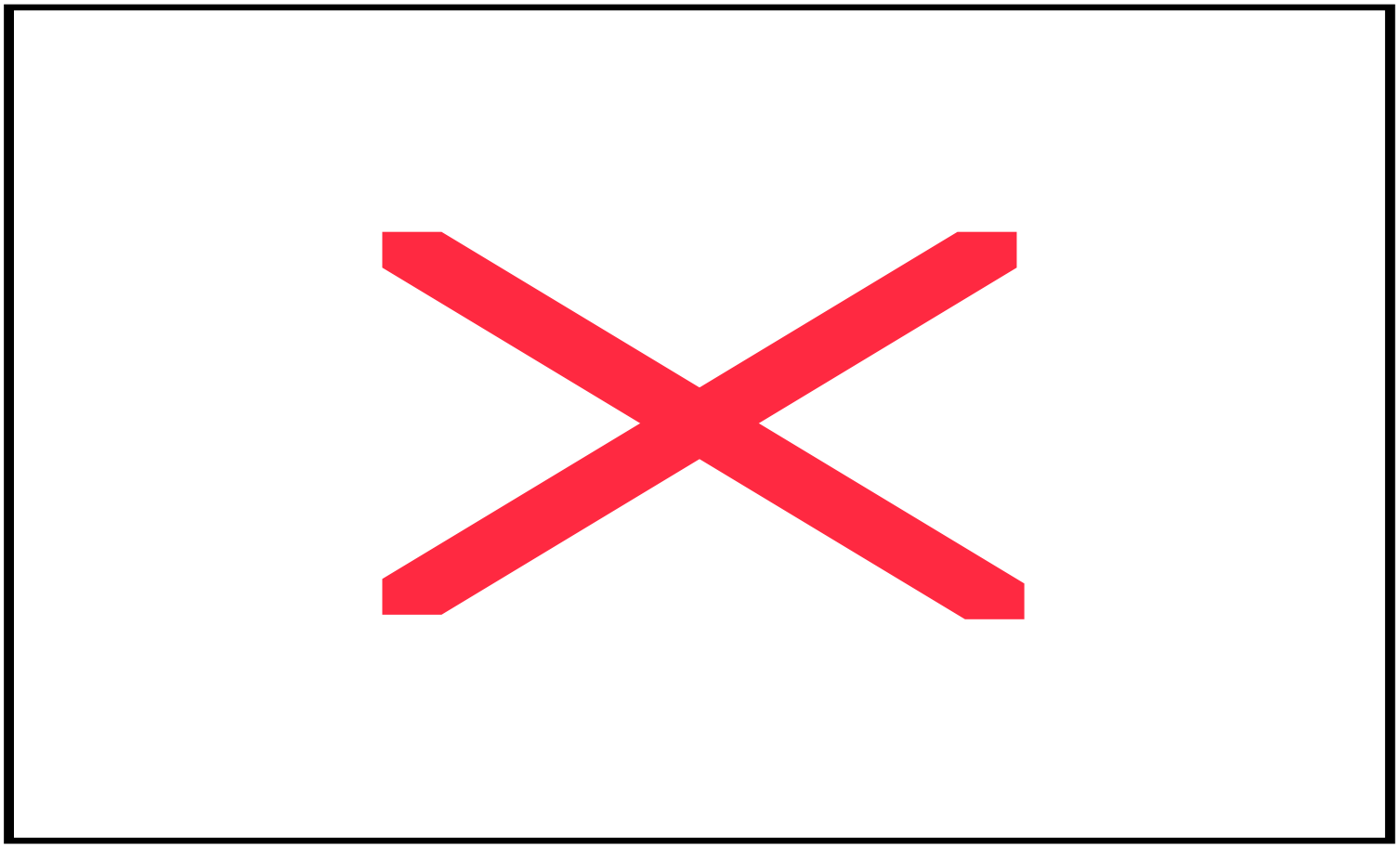
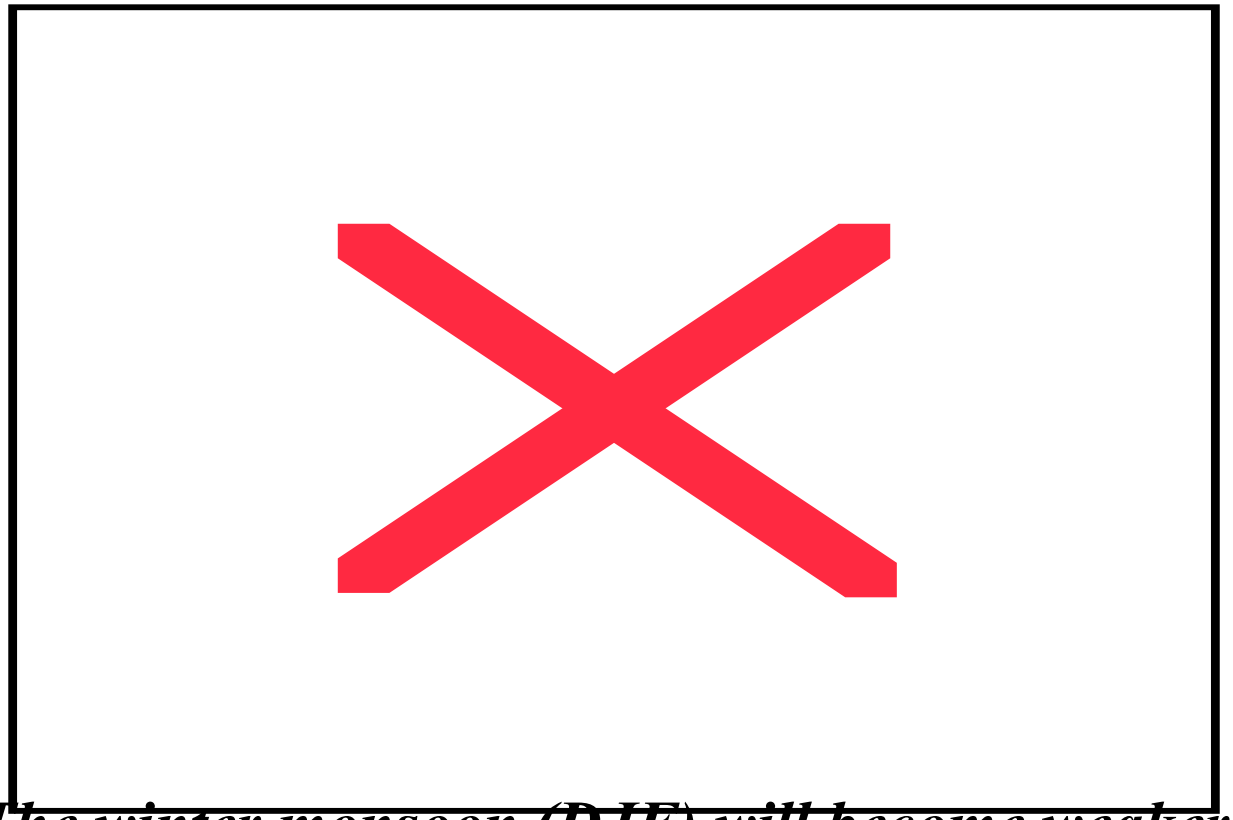
Frequency of cold waves for Dec-Feb in East Asia (NCC.2002)

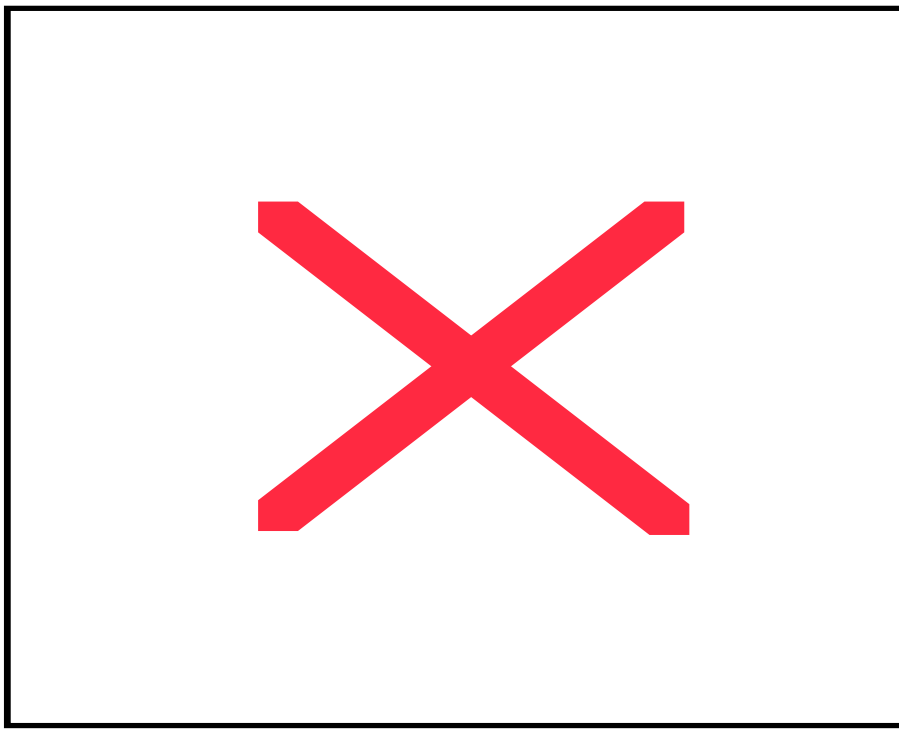


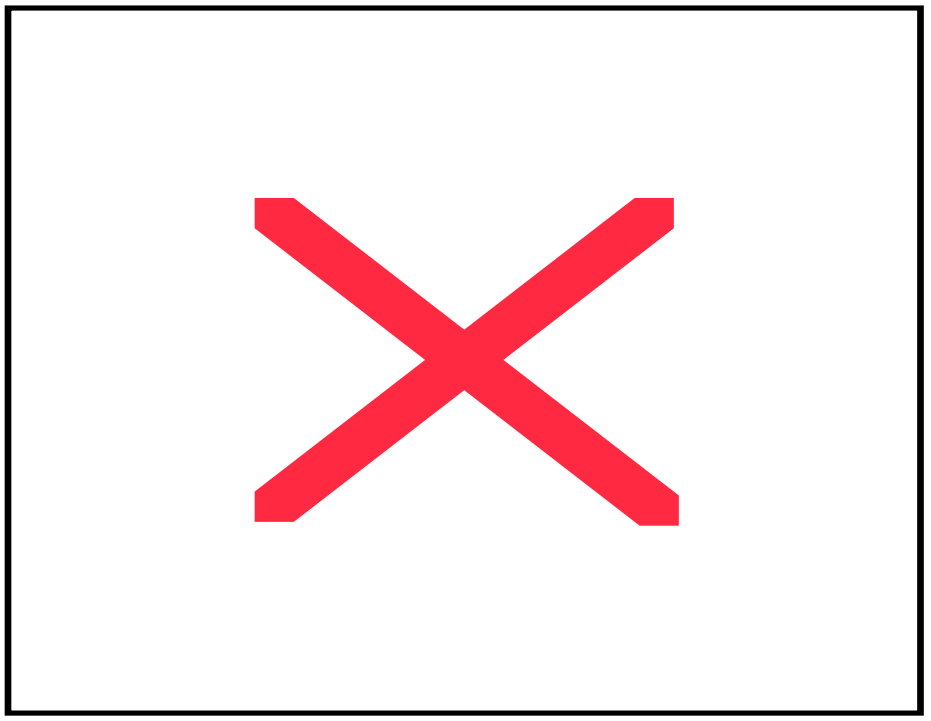
The time-series of Change of winter mon… …050)



The winter monsoon (DJF) will become weaker in the future over East Asia

850 hPa V (m/s) change in winter

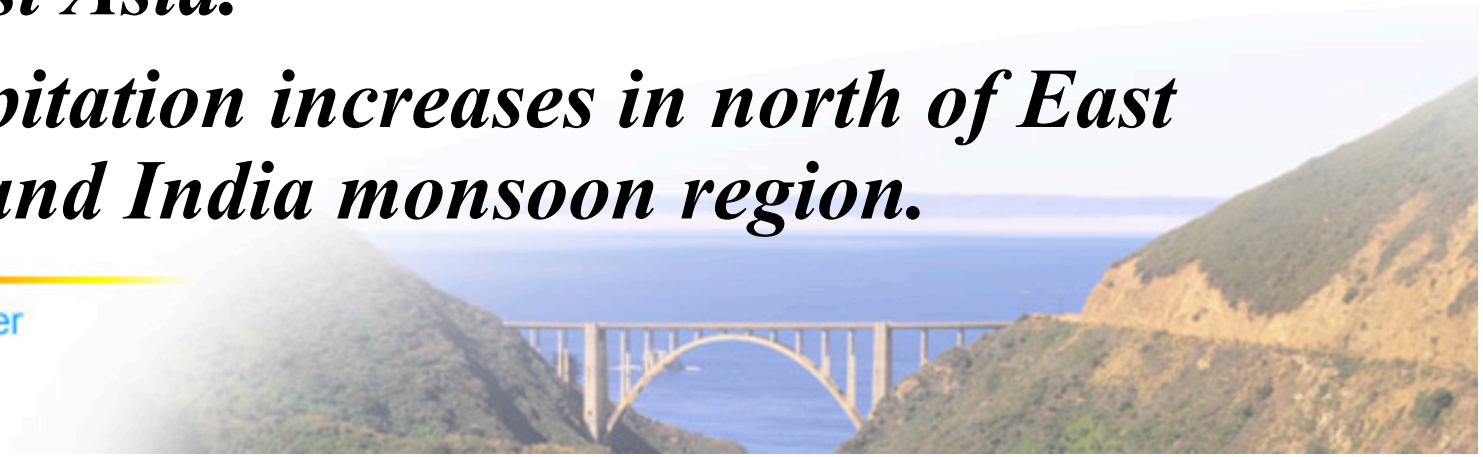




The 850hPa meridional wind becomes weaker in mid-high latitude

Summary

- ***Annual mean temperature will increase in East Asia and China.***
- ***The warming is most significant in winter in East Asia and China.***
- ***The warming is most significant in north of East Asia.***
- ***Precipitation increases in north of East Asia and India monsoon region.***



Summary

- ***The intensity of summer monsoon will increase over South Asia and South China Sea.***
- ***Tropical monsoon becomes stronger.***
- ***Winter monsoon has changed over East Asia, with a decreasing tendency in intensity in North China.***
- ***Intensity and frequency of cold waves in East Asia will be decreasing.***

Thanks for your attention!

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